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3. That the attached is, to the best of RWS Group Ltd knowledge and belief, a true translation into the English language of the accompanying copy of the specification filed with the application for a patent in Germany on 15 October 2002 under the number 102 48 022.2 and the official certificate attached hereto.
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For and on behalf of RWS Group Ltd
The 4th day of December 2006

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Priority Certificate

DE 102 48 022.2

for the filing of a Patent Application

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Applicant/Proprietor:	LANXESS Deutschland GmbH, 51373 Leverkusen/DE; ADOB-Przedsiebiorstwo Produkcyjno Consultingowe, Poznan/PL. First applicant: BAYER AKTIENGESELLSCHAFT, 51373 Leverkusen/DE; ADOB-Przedsiebiorstwo Produkcyjno Consultingowe, Poznan/PL.
Title:	Chelated plant micronutrients
IPC:	C 05 D 9/02

The attached documents are a correct and accurate reproduction of the original submission for this Application.

Munich, 23 November 2006
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Chelated plant micronutrients

The present invention relates to chelated plant micronutrients comprising the reaction product of the sodium, potassium, sodium/ammonium or potassium/ammonium salts of N-(1,2-dicarboxyethyl)-D,L-aspartic acid and their mixtures with metal ions selected from the group of the inorganic or organic zinc, manganese, iron(II), iron(III) or copper(II) compounds, and to a process for the preparation of these chelated micronutrient fertilizers.

Micronutrients such as iron, copper, zinc and manganese are applied in order to ensure proper plant growth. Micronutrients in chelated form are taken up better by the plants, and deficiency, which leads to reduced yields, is compensated for.

The use of metal ions in chelated form which are prepared with suitable complexing agents with high stability constants is already known from the prior art. Chelated metal ions ensure a rapid uptake and translocation within the plant under different growth conditions, such as soil pH, interaction between soil components, climatic conditions, bicarbonate content, redox potential and other parameters.

Chelated iron(II), iron(III), manganese, copper and zinc ions are used in the form of individual trace elements or in the form of mixtures and as additives for NPK complete or compound fertilizer (NPK = nitrogen-phosphorus-potash).

For example, the patent DE-A 3 517 102 discloses a liquid fertilizer comprising chelated iron(III), manganese, copper, zinc or cobalt in the form of nitrates having a pH of 4 to 8 and a concentration of 40.3% up to 62.7% of the dry matter. In the abovementioned prior art, the chelating agents nitrilotriacetic acid (NTA), ethylenediaminotetraacetic acid (EDTA), diethylenetriaminopentaacetic acid (DTPA), N-hydroxyethylethylenediaminotriacetic acid (HEEDTA), ethylenediaminedi(o-hydroxyphenylacetic acid) (EDDHA) are used separately or in combination with their sodium, potassium and ammonium salts in a molar ratio of metal to chelating agent of at least 0.1:1.0 to 5:1, preferably 0.8:1 to 2.5:1.0.

Most of the synthetic chelating agents mentioned in the prior art are not biodegradable and, accordingly, accumulate in soils and water courses.

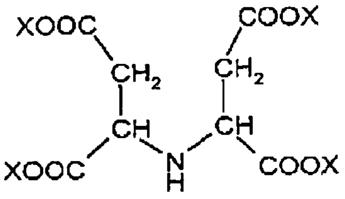
DE-A 1 0219 037 describes a process for the preparation of ammonium/metal salts of iminodisuccinic acid and their possible use as micronutrient fertilizers. However, it lacks any suggestion that the divalent, trivalent or tetravalent alkali metal or alkali metal/ammonium mixed salts of N-(1,2-dicarboxyethyl)-D,L-aspartic acid or their mixtures meet the demands of a biodegradable micronutrient fertilizer particularly well.

It was therefore an object of the invention to provide the plants with plant micronutrients in chelated form, to bind the micronutrients in chelated form and to provide the plants with sufficient amounts of the latter, combined with as high as possible a biodegradability of the chelating agents.

The object is achieved by providing the plants to be treated with chelated micronutrients comprising the divalent, trivalent or tetravalent alkali metal or alkali metal ammonium mixed salts of N-(1,2-dicarboxyethyl)-D,L-aspartic acid or their mixtures as compound A and polyvalent metal ions selected from the group of Fe(III), Fe(II), Mn, Cu or Zn as compound B, as well as conventionally used additives.

The chelated plant nutrients are to be at least 70.0% biodegradable over a period of 28 days as specified in OECD Guideline No. 301 E. They are therefore outstandingly suitable for fertilizing plants, in particular useful plants.

The invention preferably relates to compounds of the formula A



(A)

where

X represents potassium, sodium, ammonium or hydrogen and the degree of substitution for potassium and/or sodium is in the range from 2 to 4, preferably 3.5 to 4, and the degree of substitution for hydrogen and/or ammonium in the range from 0 to 2, preferably 0 to 0.5.

This results for example in the following substitution patterns:

3 X are sodium and 1 X is hydrogen or 4 X are sodium or 3 X are sodium and 1 X is ammonium or 3 X are potassium and 1 X is hydrogen or 4 X are potassium or 3 X are potassium and 1 X is ammonium or 2 X are potassium and 1 X is ammonium and 1 X is hydrogen.

Preferred compounds B are in accordance with the invention carbonates, chlorides, sulphates, oxides, hydroxides, acetates and nitrates of the metals iron(III), iron(II), manganese, copper and zinc.

Preferred in accordance with the invention is a molar ratio between the chelating agent A and the metal ion B in the range from 1.3-0.8 to 1.0-0.9.

The chelated micronutrients according to the invention are prepared in liquid or else in solid form and optionally contain conventionally used additives.

The liquid products according to the invention contain 1.0 to 6.0% by weight of the micronutrient, the preferred molar ratio to the chelating agent being 0.95 to 1.0.

The solid products according to the invention contain 5.0 to 14.0% by weight of the micronutrient, the preferred molar ratio to the chelating agent being 0.95 to 1.0.

Moreover, the chelated micronutrients according to the invention may contain other micronutrients which are used in agriculture, horticulture or hydroponics, such as calcium, magnesium, boron, molybdenum or cobalt.

It has been found that the chelated micronutrients according to the invention can be applied as individual chelates or mixtures thereof with other known complex-forming compounds from the series of the aminopolycarboxyl compounds, polyaminocarboxyl compounds, poly- and bicarboxyl compounds, hydroxypolycarboxyl compounds, hydroxypolyaminocarboxyl compounds and, if appropriate, as a constituent of NPK complete and compound fertilizers, which widens their field of application and increases their efficacy.

Preferred complete fertilizers are nitrogen fertilizers, phosphorus fertilizers or potash fertilizers.

It is preferred in accordance with the invention for the chelated plant micronutrient additionally to contain wetters or adhesives. Wetters or adhesives which are preferred in accordance with the invention are Cycocel®, lignosulphonates or gluconates.

The present invention furthermore relates to a process for the preparation of the finished products in solid or liquid form.

Chelating is effected with the complexing agent A having an imino group and polyhydroxyl groups and an inorganic compound B of a chloride, nitrate, acetate, sulphate or carbonate, hydroxide or oxide of the polyvalent metal ions, of iron, manganese, copper or zinc, with addition of inorganic or organic acids. Preferred acids for the purposes of the present invention are hydrochloric acid, sulphuric acid, nitric acid or acetic acid.

In order to convert the resulting products into solid form, the liquid micronutrient fertilizers are dried in a spray-drier. To this end, the liquid products are advantageously first filtered and then sprayed into a spray tower at a pressure of 15-60 bar, preferably 35-45 bar, using suitable nozzles. The inlet temperature of the spray tower is 100-300°C, preferably 120-250°C, and the outlet temperature is 50-150°C, preferably 70-120°C. This gives almost dust-free microgranules with a particle size of 50-400 µm, preferably 80-300 µm. It has proved advantageous to cool the microgranules as they are obtained to approx. 30°C and to condition them with an antiadhesive. Products which can be used for this purpose are, for example, those of the Hostapur® series of products.

Possible ways of applying the liquid product or solid product according to the invention include foliar sprays, soil application, hydroponics and fertigation.

Examples

Example 1

23 ml of a stirred 34% tetrasodium N-(1,2-dicarboxyethyl)-D,L-aspartate solution were treated at 40°C with 20 ml of an 18.0% zinc chloride solution.

Following reaction for one hour after addition of 0.3% lignosulphonate as adhesive, a storage-stable transparent solution was obtained.

The Zn content was 3.74% by weight.

Example 2

19.6 ml of a stirred 34% tetrasodium N-(1,2-dicarboxyethyl)-D,L-aspartate solution were treated dropwise at 60°C with 20 ml of a 20% manganese(II) nitrate solution.

After 2 hours of reaction at 60°C, 0.5% Cycocel® was added as wetting agent, whereby a storage-stable orange transparent solution was obtained.

The Mn content was 2.9% by weight (w/w).

Example 3

12.9 ml of a stirred 47.0% ammonium dipotassium N-(1,2-dicarboxyethyl)-D,L-aspartate solution were treated at 40°C with 20 ml of a 27.0% copper(II) nitrate solution.

After 2 hours of reaction at 40°C, 0.5% Cycocel® was added as wetting agent, whereby a storage-stable blue transparent solution was obtained.

The Cu content was 3.8% by weight.

Example 4

20 ml of a stirred 12.0% iron(III) nitrate solution were treated at 40°C with 11.5 ml of a 34% tetrasodium N-(1,2-dicarboxyethyl)-D,L-aspartate solution.

After reaction for 2 hours with exclusion of light at 40°C, 0.5% Cycocel® and 0.5% lignosulphonate were added as wetting agent and adhesive, respectively, whereby a storage-stable dark green transparent solution was obtained.

The Fe(II) content was 2.22% by weight.

Example 5

20 ml of a stirred 12.0% iron(III) nitrate solution were treated at 60°C with 11.5 ml of a 34% tetrasodium N-(1,2-dicarboxyethyl)-D,L-aspartate solution.

After reaction for 1 hour, 0.5% of oxidant as well as 0.5% of Cycocel® and 0.5% of gluconate as wetting agent and adhesive, respectively, were added, and stirring was continued for 1 hour.

The final solution was a storage-stable transparent dark red liquid.

The Fe(III) content was 2.2% by weight.

Example 6

393.5 ml of a stirred 34.0% tetrasodium N-(1,2-dicarboxyethyl)-D,L-aspartate solution were treated at 60°C with 45 ml of a 20.0% zinc nitrate solution, 33.7 ml of a 27.0% copper(II) nitrate solution, 310.5 ml of a 12.0% iron(III) nitrate solution, 133.8 ml of a 20.0% manganese nitrate solution, 13.7 g of boric acid and 60.8 g of magnesium nitrate.

After reaction for 2 hours at 60°C, a storage-stable transparent dark green solution was obtained.

The solution contained:
Zn - 0.3%
Cu - 0.3%
Fe - 1.1%
Mn - 0.8%
B - 0.2%
MgO - 0.8%

All percentages are by weight.